

## CLAIMS

What is claimed is:

1. A multi-point touch pad, comprising:

a touch layer having a top surface and a bottom surface and a plurality of pressure

5 sensing devices coupled to the bottom surface of the touch layer such that touch pressure applied to the top surface will impart pressure to the pressure sensing devices near the location of the touch pressure;

each pressure sensing device coupled to a processor constructed to calculate the location of at least two points on the top surface being touched, based on pressure sensing readings from the pressure sensors.

2. The touch pad of claim 1, wherein the processor is also constructed to calculate the pressure applied at each point being touched.

3. The touch pad of claim 1, wherein the pressure sensing device comprises a sensor selected from the group consisting of force sensing resistors, piezoelectric sensors and capacitive touch sensors.

4. The touch pad of claim 1, wherein the pressure sensing device comprises a strain gauge.

5. The touch pad of claim 1, wherein the processor is a digital signal processor (DSP).

20 6. The touch pad of claim 1, wherein the pressure sensors are arranged in a matrix.

7. The touch pad of claim 4, wherein the sensors are arranged in a matrix.

8. The touch pad of claim 1, wherein the processor is constructed to perform the following algorithm:

a. sampling the pressure sensing signals from the plurality of pressure sensing devices;

b. calculating locations of single or multiple touches on the touch pad;

c. calculating the amount of pressure exerted on each touch on the touch pad;

d. outputting calculation data.

5 9. The touch pad of claim 8, wherein the processor is constructed to perform the algorithm which contains the known positions of the strain gauges on the multi-point touch pad; positions are identified with the following formula:  $(a_i, b_i)$ ,  $i = 1, 2, \dots, N$ ,

where  $N$  is the number of strain gauges, and the measured pressures of strain gauges are  $p_i$ ,  $i = 1, 2, \dots, N$ ;

the positions of the touch points on multi-point touch pad are identified with the following formula:  $(x_j, y_j)$ ,  $j = 1, 2, \dots, M$ , where  $M$  is a known number of the touch points (less than  $N$ ), but  $x_j$  and  $y_j$  are unknown and will be determined by the calculations of the formula;

the pressures of the touch points are identified with the formula:  $z_j$ ,  $j = 1, 2, \dots, M$ , which are also to be calculated using the algorithm;

the algorithm transfers the sampling data from a DSP sampling module to a processor calculation module where the algorithm calculates the position and pressure of the touch points using the following mathematical formula:  $p_i = w(|(x_1, y_1) - (a_i, b_i)|)z_1 + 20 w(|(x_2, y_2) - (a_i, b_i)|)z_2 + \dots + w(|(x_M, y_M) - (a_i, b_i)|)z_M$ ,  $i = 1, \dots, N$ ; where  $w(|(x_i, y_i) - (a_i, b_i)|)$  is a weighting factor that reflects the effect of pressure  $z_j$  on  $p_i$ ;

the algorithm calculates that:  $w(|(x_i, y_i) - (a_i, b_i)|)$  is a function of the distance between the touch point  $(x_j, y_j)$  and the sensor location  $(a_i, b_i)$ ;

the algorithm calculates that  $|(x_j, y_j) - (a_i, b_i)| = \sqrt{(x_j - a_i)^2 + (y_j - b_i)^2}$  as being the distance between the touch point of  $j$  and the sensor  $i$  using the notation “sqrt” as being representative of square root.

10. A method of controlling an application with a touch pad, comprising the 5 steps of:

providing a touch pad having a touch surface with a bottom and a top and a plurality of pressure sensors arranged under the touch surface and coupled to the bottom of the touch surface;

touching the top of the touch surface at at least two points;

sending a signal to a processor corresponding to the pressure at each sensor;

performing an algorithm to determine the location of the at least 2 touch points based on comparing the pressure at each of the sensors.

11. The method of claim 10, further comprising the step of:

calculating the pressure applied at each point being touched.

12. The method of claim 10, wherein the:

pressure sensing device is selected from the group consisting of force sensing resistors, piezoelectric sensors and capacitive touch sensors.

13. The method of claim 10, wherein the:

pressure sensing devices comprise strain gauges.

20 14. The method of claim 10, wherein the:

processor is a digital signal processor (DSP).

15. The method of claim 10, wherein the:

pressure sensors are arranged in a matrix configuration.

16. A method of claim 13, wherein the:

sensors are arranged in a matrix.

17. The method of claim 10 wherein the:

processor performs an algorithm comprising the steps of:

5 a. sampling the signals from the plurality of strain gauges;

b. calculating locations of single or multiple touches on the

touch pad;

c. calculating the amount of pressure exerted on each touch

on the touch pad;

d. outputting calculation data from the algorithm to control

the application.

18. The method of claim 10 further comprising the step of:

identifying the strain gauge positions with the formula:  $(a_i, b_i)$ ,  $i = 1, 2,$

$\dots, N$ , where  $N$  is the number of strain gauges, and the measured pressures of strain gauges are

$p_i$ ,  $i = 1, 2, \dots, N$ ;

programming the positions of the touch points on multi-point touch pad as

$(x_j, y_j)$ ,  $j = 1, 2, \dots, M$ , where  $M$  is a known number of the touch points (less than  $N$ ), but  $x_j$

and  $y_j$  are unknown and will be determined by the calculations of the algorithm;

quantifying the pressures of the touch points with the formula  $z_j$ ,  $j = 1, 2,$

20  $\dots, M$ , using the algorithm;

transfer sampling data from a sampling module to a calculation module;

calculate the position and pressure of the touch points using the following

mathematical formula:  $p_i = w(|(x_1, y_1) - (a_i, b_i)|)z_1 + w(|(x_2, y_2) - (a_i, b_i)|)z_2$

+...+ w(  $|(x_M, y_M) - (a_i, b_i)|$  )z\_M, i = 1, ..., N; where w(  $|(x_i, y_j) - (a_i, b_i)|$  ) is a weighting factor that reflects the effect of pressure  $z_j$  on  $p_i$  using the algorithm;

calculate that: w(  $|(x_i, y_j) - (a_i, b_i)|$  ) is a function of the distance between the touch point  $(x_j, y_j)$  and the sensor location  $(a_i, b_i)$  using the algorithm;

5 calculates that  $|(x_j, y_j) - (a_i, b_i)| = \sqrt{(x_j - a_i)^2 + (y_j - b_i)^2}$  as being the distance between the touch point of j and the sensor i using the notation “sqrt” as representing square root using the algorithm.